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EPIDEMIOLOGY COUNCIL NEWSLETTER – NOVEMBER 2019

FROM THE CO-CHAIRS

Hi members

Welcome to the first newsletter of the Epidemiology Council. The Epidemiology Council was established to help increase ISPAH members' knowledge of contemporary causal inference and quantitative bias assessment methods. We believe that this is important for advancing the science of physical activity epidemiology.

The flagship project of the Epidemiology Council is the Physical Activity Cohort Study Repository (PACE). An extensive review of existing cohort studies worldwide will be conducted in order to establish which studies have collected data on physical activity and sedentary behaviour (self-report and/or device-based measurement). We will compile a central repository of information about these cohorts, to be housed in the members only section of the ISPAH website. We are seeking volunteers to help with title and abstract screening and/or data extraction as part of a systematic review to identify relevant cohort studies. Volunteers will be invited to contribute as authors to a manuscript related to the systematic review. If you are interested in joining the PACE team, please email Andrea Ramirez Varela at: aravamd@gmail.com

We're planning an online journal club via Twitter soon. All Epidemiology Council members will be emailed a methods paper to read, and provided with details about the Twitter journal club and how it will run. We hope you can join us!

With best wishes
Brigid and Terry
Co-Chairs
Epidemiology Council
Contact us:
brigid.lynch@cancervic.org.au
terry.boyle@unisa.edu.au

DIRECTED ACYCLIC GRAPHS: A PRIMER

The objective of many epidemiological studies is to determine the likelihood of an observed association between an exposure and an outcome being causal. To assess this, investigators must carefully exclude non-causal explanations for observed associations, particularly the effect of confounding variables. During design and analysis phases, investigators must take thorough account of the assumed causal structure underlying the relationship between their variables of interest. Causal diagrams are graphical representations that help the researcher visualise, justify, and communicate their assumptions about this causal structure. Causal diagrams help determine the set of factors which should be measured in a study, and variables which should (i.e., confounders) and should not (i.e., mediators and colliders) be adjusted for in statistical models. Causal diagrams can suggest likely causal pathways between an exposure and outcome. They can also help to estimate the potential severity of residual confounding due to unmeasured factors. Other potential sources of bias in epidemiological studies, such as selection bias, or the relative importance of variables prone to information bias, can also be identified using causal diagrams.

Directed acyclic graphs (DAGs) are the most common type of causal diagrams used in epidemiology. All relevant variables are depicted in one diagram, with arrows between the variables showing their hypothesised causal interconnectedness. An arrow from variable X to variable Y indicates that the researcher believes X causes Y, that is, there is a causal path from X to Y. The arrows must be unidirectional (if variable X causes Y, Y cannot also cause X). If the researcher thinks this may be so, a DAG accounting for changing characteristics over time is probably required: for instance, so that X at timepoint 1 causes Y at timepoint 2, which causes X at timepoint 3. As the name suggests, DAGs must be acyclic, which means a variable cannot cause itself via its influence on other variables. For a DAG to be useful, all putative causes of the exposure which may also influence the outcome (that is, confounders), must be visualised. DAGs have specific notation which may be helpful when communicating the assumptions in the diagram. An 'open' path is a direct causal pathway between two variables (i.e., one causes the other). A 'closed' or 'blocked' path is when two variables have a common consequence (a collider). A 'backdoor' path between two variables indicates that they have a common cause (i.e., a confounder). Controlling for variables (either at design or analysis stage) can 'close' or 'open' pathways, so it is important that study design and model variable selection is performed carefully according to the DAG to ensure pathways are not opened or closed unintentionally. For instance, adjusting for variables in statistical models can close a backdoor path between exposure/outcome (necessary for causal inference), but also close an open path between exposure/outcome, or open a closed path via a collider (which may both create spurious associations).

DAGs may be particularly useful for visualising complex causal structures, such as when characteristics are measured at multiple timepoints, or when there is no clear consensus on whether a variable plays a confounding or mediating role in a particular exposure-outcome relationship. Visualising (and ideally reporting) the DAG not only helps with making critical analysis decisions, but also may help to explain any discrepancies in results between different studies examining the same relationships. Different assumptions about causal structures (and consequently different adjustment models) may explain many 'failures' to replicate associations found in epidemiological studies. For instance, in the forthcoming JPAH paper by Lynch *et al*. (see details, below) describing methods to improve causal inference in physical activity epidemiology, two example DAGs of the relationship between physical activity and mortality depict waist circumference as either a confounder or a mediator. Analytical decisions based on this causal structure (i.e., to adjust or not to adjust for waist circumference in statistical models) will result in different estimates of the association between physical activity and mortality. In the context of physical activity and sedentary behaviour epidemiology, DAGs may be particularly useful for making and visualising assumptions about the interrelation of these two variables, often inadequately accounted for.

To construct a DAG, comprehensive subject-matter knowledge (for example, from expert knowledge or comprehensive review of the literature) is required, to ensure all potential confounders (including those which were not measured in the study under consideration) are identified and entered in the DAG. Their direction of association with the exposure, outcome and other variables must be considered and noted. Depicting mediators (variables on the hypothesised causal pathway between exposure and outcome) and colliders (which are common consequences of exposure and outcome variables) will help enable these are not adjusted for in statistical models, which would create biased estimates of the association.

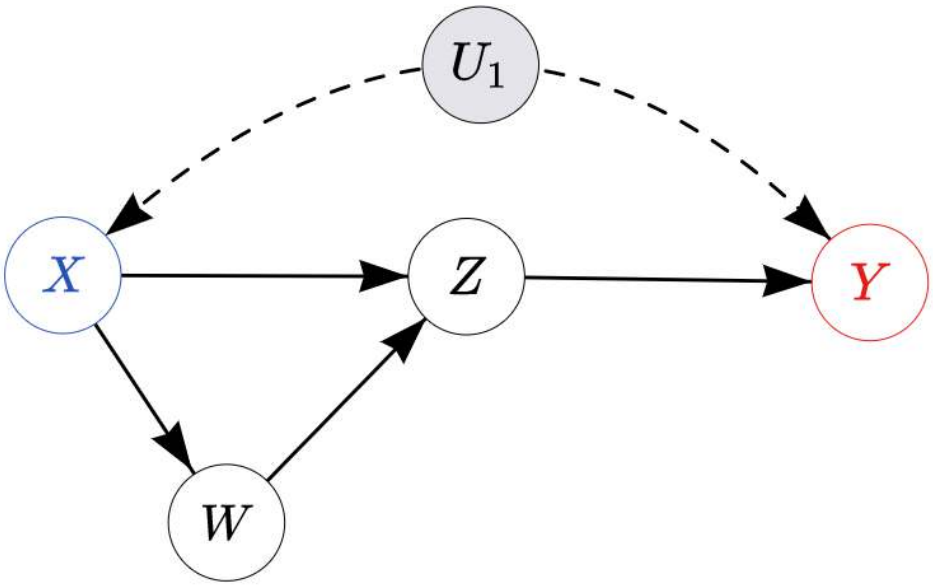
Resources to help you learn more

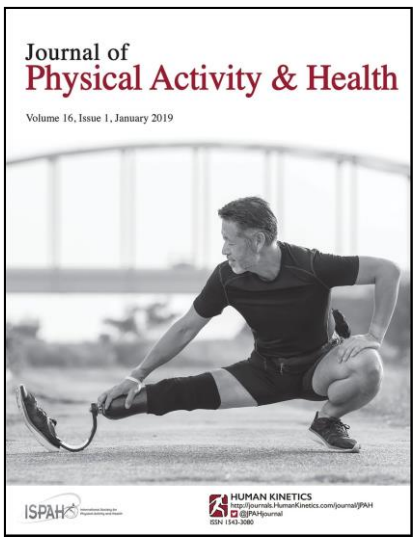
Open courseware:

EdX Course – "Causal Diagrams: Draw Your Assumptions Before Your Conclusions"
https://www.edx.org/course/causal-diagrams-draw-your-assumptions-before-your-conclusions
Estimated time input: 18-27 hours

Textbook (available online):

Hernán MA, Robins JM (2020). Causal Inference: What If. Boca Raton: Chapman & Hall/CRC.
https://www.hsph.harvard.edu/miguel-hernan/research/structure-of-bias/
See Chapter 6: Graphical representation of causal effects.





Keep an eye out for the Epidemiology Council's article "Approaches to improve causal inference in physical activity epidemiology" – coming soon in the Journal of Physical Activity and Health.

NEW EPIDEMIOLOGY COUNCIL PROJECT

Volunteers sought for a review of confounder selection in physical activity epidemiology

Choosing which confounders to include in a model is arguably one of the most important tasks when aiming to investigating the causal association between an exposure and risk of an outcome, and there are many different variable selection methods. A recent review of articles (on any exposure or outcome) published in four major epidemiology journals in 2015 found that the most commonly used variable selection methods were prior knowledge or causal graphs (50% of studies), change in effect estimate techniques (12%), stepwise methods (9%), and univariate analyses (5%) (Talbot and Massamba, 2019). Around a third of studies did not provide sufficient information about variable selection to allow classification of the methods used.

In this project we will conduct a similar study to the one conducted by Talbot and Massamba, but specifically on physical activity epidemiology. The aim is to describe current practices in variable selection in studies which use observational data to explicitly seek to estimate the (causal) association between physical activity and a health outcome (e.g., mortality, CVD risk, cancer risk). The review will use similar methods to those used in the study by Talbot and Massamba, but will use a wider range of years (e.g., 2015-2018) and a wider range of journals (e.g., sports sciences journals).

We are currently seeking volunteers for this project to help screen a portion of the studies identified in the search strategy to determine eligibility, extracting relevant data (i.e., what method was used in the variable selection process) from eligible studies, involvement in the analysis, interpretation and/or reporting of the data, and drafting and/or reviewing sections of the manuscript.

We anticipate that the results of this project will be presented at ISPAH 2020 and published in a peer-reviewed journal. If you are interested in being involved in this project, please email Terry Boyle (terry.boyle@unisa.edu.au).

EPIDEMIOLOGY COUNCIL MEMBER PROFILE

Suzanne Dixon-Suen is the Secretary for the Epidemiology Council, and an early-career cancer epidemiologist at Cancer Council Victoria. She is currently working to address research questions relating to the role of physical activity and sedentary behaviour in cancer prevention and post-diagnosis care, using data from large international consortia including the Breast Cancer Association Consortium and the National Cancer Institute Cohort Consortium. Suzanne's main research interests revolve around lifestyle risk factors for cancer, specifically disentangling the relationships between obesity, poor metabolic health, and cancer risk, and in determining how, when, and for whom lifestyle interventions to improve weight and metabolic health will prevent cancer. Her other chief research interest is meta-research (researching the research process, with the goal of improving quality and reducing waste). Suzanne's doctoral training was in ovarian cancer epidemiology at the Department of Population Health, QIMR Berghofer Medical Research Institute, and the University of Queensland. Prior to commencing her post-graduate studies, Suzanne worked in government health surveillance at the Australian Institute of Health and Welfare and the UK National Health Service.

Suzanne wrote the DAG primer for this newsletter. If you have any questions about this piece you can contact Suzanne at: suzanne.dixon-suen@cancervic.org.au